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Vol. VI SEPTEMBER, 1919 No. 7

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PROCEEDINGS

PAPER IN THIS NUMBER.

"Activities of the Construction Division, United States Army, and the Form of Contract Adopted." By R. C. Marshall, Jr.

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Contributors are hereby notified that proof will not be submitted to them for examination unless requested before the 10th of the month preceding the month of publication.

MINUTES OF MEETING.

HULL, MASS., June 25, 1919. — A regular meeting of the Boston Society of Civil Engineers was held this afternoon on the lawn of the Pemberton Inn, at the conclusion of a shore dinner which was served in connection with the Joint Field Day and Excursion of the New England Water Works Association and this Society.

Immediately following the dinner, members of the two societies and their guests were favored with a most interesting address by the Hon. William E. Blodgett, formerly mayor of Woburn, Mass.

At the close of his address a unanimous vote of thanks was tendered him by the two organizations, for his courtesy in giving in such an interesting manner his personal experiences in Y. M. C. A. work in France.

The business meeting of the Society was called to order at 3.30 o'clock by the President, Leonard Metcalf.

By vote, the reading of the record of the May meeting was postponed to the regular meeting in September.

The Secretary announced that the Board of Government at its meeting yesterday had elected to membership, in the grade of Member, Mr. Thorndike Saville.

After brief statements by the President in relation to the appointment of a committee on compensation of engineers and in relation to the establishment of a National Board of Public Works, the Society adjourned.

The total attendance of members and guests of the two organizations at the field day and excursion was 127.

S. E. TINKHAM, *Secretary.*

APPLICATIONS FOR MEMBERSHIP.

[September 15, 1919.]

THE By-Laws provide that the Board of Government shall consider applications for membership with reference to the eligibility of each candidate for admission and shall determine the proper grade of membership to which he is entitled.

The Board must depend largely upon the members of the Society for the information which will enable it to arrive at a just conclusion. Every member is therefore urged to communicate promptly any facts in relation to the personal character or professional reputation and experience of the candidates which will assist the Board in its consideration. Communications relating to applicants are considered by the Board as strictly confidential.

The fact that applicants give the names of certain members as reference does not necessarily mean that such members endorse the candidate.

The Board of Government will not consider applications until the expiration of twenty (20) days from the date given.

Abbott, Robinson, Malden, Mass. (Age 28, b. Waterbury, Conn.) Graduate of Tufts College Engrg. School, 1918. From 1908 to 1910, foreman and assistant to G. S. Abbott, contractor, Waterbury, Conn., on water supply of Morris, Conn.; from September, 1910, to March, 1913, with Wm. G. Smith, C. E., Waterbury, on electric railway surveys, construction and final estimate; from March, 1913, to September, 1914, map draftsman on city surveys with A. F. Sargent, Malden; from May to September, 1916, with Mass. Highway Comm. on preliminary surveys; December, 1918, graduated from U. S. N. Officer Material School; from January, 1919, to date, instructor in Tufts College Engrg. School. Refers to E. H. Rockwell, F. B. Sanborn, A. F. Sargent and R. C. Smith.

Brown, Leo M., Detroit, Mich. (Age 22, b. Boston, Mass.) Graduate of Tufts College, 1918, structural engineering course; past ensign, U. S. N. Was for six months civil engineer for U. S. Government at Watertown Arsenal; is now civil engineer with Thompson-Starrett Co. of New York, on General Motors plant contract in Detroit, Mich. Refers to H. L. Katz, E. H. Rockwell, F. B. Sanborn and R. C. Smith.

Clarkson, Edward Hale, Jr., Newburyport, Mass. (Age 26, b. Auburndale, Mass.) Graduate of Mass. Inst. of Technology, 1916. In 1916 and 1917, assistant instructor at Mass. Inst. of Technology; from September to December, 1917, with American Red Cross Sanitary Service; from April to December, 1918, in U. S. Army; is now sanitary engineer with International Health Board of Rockefeller Foundation on anti-malaria work in conjunction with State Board of Health of Arkansas. Elected a Junior February 21, 1917, and now desires to be transferred to grade of Member. Refers to C. B. Breed, G. L. Hosmer, J. W. Howard, Dwight Porter, C. M. Spofford and G. C. Whipple.

Giles, Ernest Palmer, San Antonio, Tex. (Age 25, b. Kerrville, Tex.) Student for two years at Univ. of Texas; graduate of Mass. Inst. of Technology, 1918, architectural engineering course, having also completed intensive course in naval architecture. Enlisted as private in U. S. Engr. Enlisted Reserve Corps; was transferred to Navy Dept., and worked for ten months at Boston Navy Yard, first as ship draftsman and later as ship superintendent, Hull Div.; since April, 1919, has been with Alfred Giles Co., architects, San Antonio; when a student, had worked for this firm during vacations. Elected a Junior, November 20, 1918, and now desires to be transferred to grade of Member. Refers to J. B. Babcock, J. J. Harty, Jr., L. J. Johnson, W. H. Lawrence, Dean Peabody, Jr., and C. M. Spofford.

EMPLOYMENT BUREAU.

The Board of Government maintains an employment bureau for the Society, to be a medium for securing positions for its members and applicants for membership, and also for furnishing employees to members and others desiring men capable of filling responsible positions.

At the Society rooms two lists are kept on file, one of *positions available* and the other of *men available*, giving in each case detailed information in relation thereto.

MEN AVAILABLE.

468. Age 26. Received technical education at Rindge Technical School and Harvard College, having graduated from latter with degree of S.B. in 1916; had eleven weeks' instruction in field at Harvard Engrg. Camp. Since graduation has been in various branches of military service, work having been chiefly observation in artillery. Desires position as axman or rodman.

469. Age 32. Has university training in engineering; member, B. S. C. E. Experience covers ten years as transitman, inspector, foreman and superintendent on various constructions. Desires engineering position dealing with concrete sewage, bridge or road construction. Salary desired, $160 per month.

473. Age 24. Has high-school education and has studied civil engineering in I. C. S. course. Has had experience in general municipal work, including sewer construction, paving and topography. Desires position as transitman or inspector of concrete. Salary desired, $1 200 per year.

474. Age 24. Graduate of Tufts College, 1917, degree of B.S. in civil engineering. Experience covers three months on topographical surveying; three months as engineer and inspector on concrete conduit construction; six months on railroad construction; six weeks on reinforced concrete building construction; and about four months on designing and laying out of drainage system and roads for large camp in France; recently discharged from army. Prefers field work as chief of party, transitman or inspector.

475. Age 28. Graduate of Mechanic Arts High School. Employed by Boston engineering firm for nine years, including four years in charge of surveying party; discharged from army June 23, 1919, after eighteen months of foreign service. Desires position as chief of party in any kind of survey work. Salary desired, $1 200 to $1 500 per year.

476. Age 31. Graduate of Mass. Inst. of Technology, civil engineering course, hydraulic option; member, B. S. C. E.; associate member, A. S. C. E. Experience includes three years as assistant engineer on miscellaneous projects, — surveys, studies, design and estimates of railroad grade-crossing projects, water power and supply, building alteration and construction, etc., — and three years in charge of branch office of Boston firm of consulting engineers, on surveys, design and construction of water supply, etc.; recently discharged from army with rank of captain, after eleven months overseas, including two months' active duty at front in command of company. Desires permanent position with firm having hydraulic department; prefers work of executive

nature involving substantially permanent residence. Salary desired, $3 000 per year.

478. Age 27. Has had high-school education and one year in college, specializing in mathematics through calculus; also special course in civil engineering with International Correspondence Schools and business training in real estate, insurance and cost accounting. Since leaving school has been conducting general civil engineering business; has had considerable court experience and done considerable land-court work. Desires to become member of engineering organization with permanent location. Minimum salary desired, $3 000 per year.

479. Age 23. Graduate of Mechanic Arts High School; entered military service of U. S., when in second year of two-year course at Lowell Inst.; was taking course in civil engineering at C. A. officers' school when discharged. Desires position as rodman, with opportunity for advancement.

480. Age 23. Went directly into naval service of U. S. from engineering course at Tufts College, having completed two years at that institution; specialized in reinforced concrete while in service and had considerable experience in road work at U. S. naval ammunition depot; has also had brief experience with firm of architects. Desires position as designer or inspector of reinforced concrete work. Salary desired, $30 per week.

481. Has had technical course in high school and I. C. S. course in surveying and mapping. Has had about six years' experience as rodman, instrumentman and chief of party, including four years on general surveying, road layouts and property research; two months with canal company on construction, and one year with city engineering department on topographical survey and street work; recently discharged from U. S. military service; experience in France covered topographical work, computing and cemetery layouts. Desires position as transitman or chief of party. Salary desired, $20 per week.

482. Age 38. Graduate of Mass. Inst. of Technology, civil engineering course. Has had about fifteen years' experience, chiefly on water-supply engineering, including preliminary work, surveys and construction, — dam, dikes, roads, etc.; served two years with engineers of A. E. F., chemical warfare service, in France and Germany; recently discharged with rank of lieutenant-colonel. Desires position as hydraulic construction engineer. Salary desired, $3 500 per year.

483. Age 23. Graduate of Cornell Univ., degree of C.E. Served twenty-one months as lieutenant with A. E. F.; was engaged in water-supply construction for one year in France. Desires position as sanitary and civil engineer. Salary desired, $200 per month.

484. Age 29. Graduate of Mass. Inst. of Technology, civil engineering course; member, B. S. C. E. Has had seven years' experience, including three years as chief of party and assistant engineer on concrete construction and topographical surveying and two years as second lieutenant in Engr. Corps, U. S. A., on railroad and building construction in France. Desires

position as inspector on construction work or as chief of party or assistant engineer on survey work. Minimum salary desired, $150 per month.

485. Age 33. High-school education. Has had fifteen years' experience as instrumentman and assistant engineer; experience includes municipal and railroad work.

486. Age 26. Four years' scientific course at Lowell High School. Has had more than seven years' experience in surveying, including two years as instrumentman on building construction and two years for government civil service engineers; has been non-commissioned head of camp engineers at army camp for year and a half; for past four months has worked on boundary survey of that camp. Desires position as transitman or chief of party.

487. Age 28. Graduate of Mass. Agricultural College, 1914; student at Trinity College, Dublin, Ireland, during spring term, 1919. Experience includes one year as transitman and draftsman on map work with Massachusetts town; about two years as topographer, construction superintendent and engineer on construction in the Middle West; and one year with the U. S. Army overseas on map drafting. Desires position as transitman on construction work or as landscape superintendent. Salary desired, $25 per week.

Address all inquiries in regard to the following to W. V. Brown, Manager, Engineering Societies Employment Bureau, 29 West Thirty-ninth St., New York, N. Y.

Captain Construction Division, U. S. A., available immediately; wishes to form connection with high-class engineer or contractor, as engineer, superintendent or executive. Technical graduate, age 35; broad construction experience. Highest references. Salary $4 800. A–4383.

Contractor's Engineer, Captain A. E. F.; graduate engineer accustomed to responsibility; successful executive; designs reports, investigations; rapid, accurate quantity estimator on all kinds of construction work. Pacific Coast preferred. A–4444.

LIST OF MEMBERS.

CHANGES OF ADDRESS.

Babbitt, John H. . . . . Engr. Dept., Penna. R. R., Akron, Ohio.
Blanchard, Arthur H. . . . . Univ. of Michigan, Ann Arbor, Mich.
Burleigh, Willard G. 40 Waverly St., Waverly, Mass.
Clarkson, Edward H. . . . . McGehee, Ark.
Davis, Wilbur W. . . . . 1 Beacon St., 6th Floor, Boston, Mass.
Depuy, Clarence S.,
Care Frank Hill Smith, Inc., 120 Broadway, Suite 3062, New York, N. Y.
Flett, Louis E. . . Care Crompton & Knowles Loom Works, Worcester, Mass.

Frame, James T. . . . . 410 Lippincott Ave., Riverton, N. J.
Horne, Ralph W. . . . . 32 Auburn St., Malden, Mass.
Hubbard, Carl P.,
Care Lockwood, Greene & Co., 38 South Dearborn St., Chicago, Ill.
Kendall, Theodore R. . . . . 334 South First Ave., Mount Vernon, N. Y.
Leavitt, Albert J. . . . . 218 Cliff Ave., Winthrop Highlands, Mass.
Lewis, George W. . . . . 99 Parkton Rd., Jamaica Plain, Mass.
Moore, Rufus R. . . . . 59 Granite St., Cambridge, Mass.
Rand, Robert . . . . . . Care Corrugated Bar Co., 27 School St., Boston, Mass.
Shaw, Arthur L. . . . . 395 Chestnut St., Clinton, Mass.
Skillin, Fred B. . . . . 15 Post Office Bldg., Albany, N. Y.
Snow, Benjamin H. . . . Care Atlantic Corp'n, Engr. Div., Portsmouth, N. H.
Sokoll, Jacob M. . . . . P. O. Box 132, Providence, R. I.
Stearns, Ralph H. . . . . Hotel Puritan, Boston, Mass.
Wade, W. Newell . . . . 65 Rawson Rd., Norfolk Downs, Mass.
Wilson, Albert O. . . . . 23 Yale St., Winchester, Mass.
Wood, Frederic J. . . . . 57 Westbourne Ter., Coolidge Corner, Mass.

DEATHS.

Gould, John A. . . . . May 18, 1919
Putnam, Charles E. . . . . August 20, 1919

NOTES FROM ENGINEERING COUNCIL.

A committee of Engineering Council on Classification and Compensation of Engineers is actively at work as three sections, dealing with engineers in employment of (1) Federal Government, (2) the railroad system, (3) municipal and state governments.

In connection with this matter the following remarks of the chairman of the committee, concerning the proposed "Classification of the Civil Service of Canada," are of interest:

Mr. Alfred D. Flinn, *Secretary*,
Engineering Council:

Dear Sir, — From time to time within the last few weeks, you have forwarded to me various letters addressed to you concerning the proposed "Classification of the Civil Service of Canada" as recommended by Arthur Young & Co. of Chicago, Toronto and New York. The copy of this classification, which was also received, indicates that its preparation was authorized by the Canadian Parliament, and that the work was done under the direction of the Civil Service Commission.

Your correspondents offer objections to the classification, particularly on the ground that the compensations proposed for higher grades of service are inadequate. In view of the investigation now being made on behalf of Engineering Council as to the classification and compensation of engineers in federal, state, municipal and railroad service, this report is of more than usual interest, and especially so since Council's committee is informed that Arthur Young & Co. are performing a similar service for the Congressional Committee on Reclassification and Compensation of Government Employees, including engineers.

Engineering Council's Committee on Classification and Compensation for the state and municipal services has tentatively proposed that all positions in these services be limited to 13 in number, of which 7 are distinctly professional, while the remaining 6 are in a class directly leading to professional work but not necessarily of a professional character. In the questionnaire recently issued by the committee, the views of the responsible heads of the services affected are being sought, and in the responses which have been received up to the present writing there has been practically unanimous agreement on the classification. The inquiry has not progressed far enough to warrant any expression as to the views concerning compensation, other than to say that there is an unquestionably strong belief that if the engineering service is to be maintained on a proper plane, there must be a very substantial increase in pay.

The Canadian report appears to cover every position in the civil service. It is arranged alphabetically, and in the absence of grouping a complete analysis of the engineering service involves a task of magnitude greater than I have found time for. I have attempted, however, to make such examination as time permitted and am impressed with a belief that the objections raised are well founded. No attempt seems to have been made to standardize titles, consequently there are in the engineering service at least 157 independent titles as compared with the 13 titles proposed by our committee. It is recognized that qualification of a general title to show the nature of the service rendered is quite proper, but in the judgment of the writer there is no reason for treating similar positions as entirely unrelated and as warranting entirely independent specifications.

The report states that the compensations proposed are intended for "normal times," and that pending restoration of such times, the rates recommended should be "supplemented by a bonus"; but no information appears as to the magnitude of the bonus.

From my study of the report it would appear that the groups and ranges of compensation, tabulated as far as practicable under the classification tentatively proposed by Engineering Council's committee, are about as follows:

Tabulation of Titles and Salaries for Engineers in Canadian Civil Service Report under Classification Proposed by Committee of Engineering Council.

Tentative Classification of Positions in State and Municipal Service proposed by Engineering Council's Committee on State and Municipal Service.	No. of Titles Provided in Proposed Canadian Classification.	Salary Range Proposed for Canadian Service.				Qualifications Proposed for Canadian Service.
		Usual.		Extreme.		
		Min.	Max.	Min.	Max.	
Consulting engineer	1	$6 000	....	....	....	Professional engr., 12 years' exper. (7 in charge).
Chief engineer (major work)	5	6 000	....	$4 800	....	Professional engr., 7–12 years' exper. (3 to 7 in charge).
Chief engineer (minor work)	7	3 900	$4 800	3 600	$6 000	Professional engr., 7–12 years' exper. (3 to 7 in charge).
Chief engineer — deputy	8	3 900	4 800	3 600	5 700	Professional engr., 7–12 years' exper. (3 to 7 in charge).
Engineer	37	3 300	4 020	3 000	4 500	Professional engr., 5–10 years' exper. (2 to 5 in charge).
Senior assistant engineer	40	2 640	3 000	2 400	3 480	Professional engr., 3 years' exper. (2 to 3 in charge).
Assistant engineer	23	2 100	2 580	2 040	3 120	Professional engr., 3 years' experience.
Junior assistant	15	1 680	2 040	1 680	2 160	Professional engr., 2 years' experience.
Senior draftsman	....	....	Included in professional service.			
Draftsman	8	1 260	1 560	....	....	3 years' experience.
Junior draftsman	4	900	1 200	....	....	2 years' experience.
Chief instrumentman	....	....	Included in professional service.			
Instrumentman	5	1 260	1 560	....	....	3 years' experience.
Rodman	4	900	1 200	....	....	2 years' experience.

In general, promotion through most of the grades is by increments of about $120, the minimum and maximum rates of each being respectively higher and lower than the rates fixed for the grades below and above, this resulting in a comparatively small salary range for each position and in this respect corresponding with what seems to have been the general practice heretofore. This treatment is one which it would seem desirable to modify, to the end that the relative ability and experience of men performing similar work may be given adequate recognition.

Exceptions are noted in the case of "topographical engineers," where a salary range of from $2 160 to $3 120 is proposed; and in the case of promotion from "junior electrical engineer" at a maximum salary of $1 980 to "electrical engineer" with a minimum salary of $2 640, each of the two latter grades having an extreme salary range of only $360. In the case of "chief draftsman," "structural engineer," and "chief topographical engineer," maximum salaries are proposed of $3 000, $3 240 and $3 840, with no provision for promotion to other engineering grades, although for each position the qualifications required are such as to indicate ability to progress to high positions in the service.

The table also shows that only 6 engineering positions are open to compensation at a rate of more than $6 000 per annum.

It would seem to the writer that this report is open to serious criticism on the ground that it fails to group engineering service along orderly lines, that it provides too narrow limits for promotions within a grade, and that the compensation proposed for all grades is inadequate for the service rendered. The latter criticism seems particularly pertinent in comparison with the rates now being demanded by organized labor. The practicability of properly meeting present-day conditions by the addition of a "special war bonus" to the proposed rates in order to meet the present high cost of living is also to be questioned on the ground that, and as set forth in the circular letter issued by Council's Committee on Classification and Compensation of State and Municipal Engineers, the "revolutionary change in the cost of living" is one which "unless modified by further economic disturbance is likely to be permanent or to continue for a long time to come."

Very truly yours,

(s/d) Arthur S. Tuttle,
Chairman, Committee on Classification and Compensation of Engineers, and of State and Municipal Section.

LIBRARY NOTES.

Recent Additions to the Library.

U. S. Government Reports.

Annual Report of Chief of Weather Bureau for 1917–18.

Anvik-Andreafski Region, Alaska. George Harrington.

Alaskan Mining Industry in 1917. G. C. Martin.

Cadmium in 1918. C. E. Siebenthal.

Contributions to Economic Geology, 1918: Part I.—Metals and Nonmetals except Fuels, F. L. Ransome and others; Part II.—Mineral Fuels, David White and others.

Employment Management, Employee Representation and Industrial Democracy.

Evaporation and Concentration of Waters Associated with Petroleum and Natural Gas. R. Van A. Mills and Roger C. Wells.

Fuel Briquetting in 1918. C. E. Lesher.

Gold and Silver in 1917. H. D. McCaskey and J. P. Dunlop.

Important publications of United States Coast and Geodetic Survey appearing since January 1, 1914.

Iron Ore, Pig Iron and Steel in 1917. Ernest F. Burchard.

Lumber Export and Our Forests. Henry S. Graves.

Municipal Markets in Cities having population of over 30 000. 1918.

(The) Nenana Coal Field, Alaska. G. C. Martin.

Readjustment and Reconstruction Activities in Foreign Countries.

Salt Resources of United States. W. C. Phalen.

Structure and Oil Resources of Simi Valley, Southern California. William S. W. Kew.

Water-Supply Paper 411.

State Reports.

Connecticut. Annual Report of Highway Commissioner for 1918.

Connecticut. Annual Report of Public Utilities Commission for 1918.

Maine. Annual Reports of Public Utilities Commission for 1917 and 1918.

Maine. Biennial Report of State Department of Health for 1916 and 1917.

Massachusetts. Annual Report of Metropolitan Park Commission for 1918.

Massachusetts. Annual Report of Public Service Commission for 1918, Vols. I and II.

New Hampshire. Annual and Statistical Report of Public Service Commission for 1916–17.

City and Town Reports.

Boston, Mass. Reports and Communications of Finance Commission, Vol. XIV, 1919.

Brockton, Mass. Annual Report of Water Commissioners for 1918.

Brookline, Mass. Annual Report of Water Board for 1918.

Burlington, Vt. Annual Report of Water Department for 1918.

Marlborough, Mass. Annual Report of Water and Sewage Commissioners for 1918.

New York, N. Y. Contract of Board of Water Supply for Construction of Gilboa Dam, 1919.

Newton, Mass. Annual Report of Water Commissioner for 1918.

Reading, Mass. Annual Report of Water Commissioners for 1918.

Reading, Pa. Annual Report of Bureau of Water for 1916.

Rochester, N. Y. Report on Problem of Refuse Collection, 1919.

Somerville, Mass. Annual Reports for 1918.

Worcester, Mass. Annual Report of Superintendent of Sewers for 1918.

Miscellaneous.

Aircraft Year Book, 1919. Manufacturers' Aircraft Association, Inc.

Canada, Department of Mines: Annual Report on Mineral Production of Canada during Calendar Year 1917.

Cross Drum Water-Tube Boilers. E. Keeler Co.

Record of War Activities. Turner Construction Co. Gift of C. T. Main.

Remarks on Present System of Road Making. John Loudon McAdam. Gift of C. S. Parsons.

Standard Reinforced Spiral Pipe: Catalogue No. 7.

LIBRARY COMMITTEE.

Vol. VI SEPTEMBER, 1919 No. 7

BOSTON SOCIETY OF CIVIL ENGINEERS
FOUNDED 1848

PAPERS AND DISCUSSIONS

This Society is not responsible for any statement made or opinion expressed in its publications

ACTIVITIES OF THE CONSTRUCTION DIVISION, UNITED STATES ARMY, AND THE FORM OF CONTRACT ADOPTED.

By R. C. Marshall, Jr.,* Brigadier-General, Corps of Engineers, U. S. A.

(Presented March 19, 1919.)

It was suggested to me that I address my remarks this evening to the general subject of the method of contract under which construction operations can be most effectually and equitably carried out. It is with a certain amount of diffidence that I undertake such a discourse, for the subject is so vast and there are so many matters that bear upon methods and forms of contracts for construction work, that in an address of this nature a speaker can at best speak only in very general terms.

I can say truthfully that I am quite familiar with the working of one particular form of contract; that is, the form of contract under which the construction work for the army has been carried on during the period of the war and under the provisions of which construction work was undertaken and is being brought to a close, aggregating in cost in the neighborhood of a billion of dollars.

Before addressing myself strictly to the subject in hand, it may be well to give a sketch or outline of what this War Department work has consisted and the organization by which it has been carried out. The bureau of the War Department with which I have been associated is the Construction Division of the Army — a bureau set up for the purpose of performing all of the vast amount of construction work which was made necessary by our entry into the war. The work itself ranged from the construction of the camps and cantonments, wooden cities, built within a period of three months, and of a type of construction of the most temporary character, to the port terminals, — projects of steel and concrete, the last word in modern permanent warehouse and dock construction.

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* Chief of Construction Division, U. S. Army, Washington, D. C.

From the beginning of its operations, when it was called upon to build the sixteen National Army cantonments and the sixteen National Guard camps, between the latter part of June and the middle of September of 1917, its operations constantly became larger in extent, greater in volume and more diversified in character. Speed was always the primary and governing factor in its work. Every reasonable economy was striven for, but speed was essential. The cost of delay would have been computed not in money alone but in the lives of our soldiers and those of our Allies.

In the beginning, the thirty-two camps and cantonments were a hurry-up call of the first magnitude. In the middle of June, 1917, except in the case of two of the cantonments, not even the sites had been selected although it was proposed to call out the drafted men early in September. In ninety days plans had to be completed, contracts prepared, contractors selected and the field forces organized; and at each of the sites (confining ourselves now to the cantonments), built complete, a camp to cost about $8 000 000 and to house, roughly, forty thousand men and ten thousand animals. Each of these camps had to be complete, with housing, railroad tracks, roads, water and sewer installations, etc. Each was a veritable city, with modern facilities for its inhabitants. It is easy to see that planning, engineering and the construction had to go hand in hand. There was no time for an orderly review of requirements and the careful drawing up of plans and specifications — work had to be begun immediately.

One of the principles of the Construction Division, adopted in the beginning and adhered to throughout the construction work, was the utilization of existing organizations. It was the opinion of those in charge that not only would these organizations, built up to a high degree of efficiency through the experience of many years, be of tremendous value to the Government, but it was also realized that they should be maintained as important factors in the economic life of the nation. Private building was practically at a standstill, and it was of the utmost importance that the great contracting organizations of the country should not be disrupted and destroyed. For these reasons, aside from the inherent impossibility of performing the War Department construction work with its own organization, it was determined to use the great contracting organizations of the country. In fact, there was no organization of the Government adapted to the purpose, and many more months would have been necessary for the formation of such an organization than were allowed for the completion of the work. The administration of such work under any such method of procedure would have been impossible.

Given the necessity of adopting the existing organizations of the country, the problem remained of how and under what form of contract these organizations were to be employed. The ordinary methods of procedure were pretty generally known, and each was carefully considered by those in charge of the work and by the Emergency Construction Committee of the Council of National Defence. This was one of the subcommittees of that council, designed to aid in the construction work incident to our preparations for the war and composed in the beginning of Mr. W. A. Starrett, of New York, later commissioned a colonel in the Quartermaster Corps; Mr. Frederick Law Olmsted, of Boston; Mr. C. W. Lundorf, of Cleveland; Mr. M. C. Tuttle, of Boston, and Major William Kelly, of the Corps of Engineers. The necessity obviously was for a form of contract combining protection both to the Government and to the contractor, with extreme flexibility, capacity for adjustment to the abnormal conditions of the labor and material markets produced by war conditions, and the possibility of the utmost speed in actual construction work.

The lump-sum contract was, some years ago, almost universally employed, and for it many advantages were claimed. Given stable material and labor markets, a clear conception of the construction desired and abundant time for the preparation of plans and specifications, this form of contract may work well, assuming that in the selection of bidders precautions are taken to choose one capable of properly performing the work.

Under war conditions, such a form of contract is impossible. It is to be borne in mind that the construction for the War Department was dependent on events in Europe and the ever-changing and growing plans of the War Department. Barracks and quarters which were to be designed to accommodate the tactical units of the army were changed and expanded materially after our entrance into the war. New types of buildings for special uses were made necessary by new tactical units organized for special functions in modern warfare. As construction progressed, changes and enlargements were found to be absolutely necessary. In no case when building was started was the completed project clearly delineated or thoroughly fixed in the mind of any one concerned.

In the lump-sum contract, nothing can be done until the drawing and specifications are complete, bids received and the contract awarded; and the contract itself is inflexible in its very nature. With no clear concept of the completed project it is inevitable under this system that important changes, enlargements and additions must be provided for during the progress of the work, involving daily administration, inconvenience and expense, and almost inevitable inequity and dissatisfaction on the part of one or both of the contracting parties.

Moreover, in unstable material and labor markets, the bidder, to protect himself, must place his figures high enough to take care of any fluctuation which may reasonably be considered. This involves a speculative figure unfair to the owner and contractor alike. It is a gamble. The contractor may be reimbursed to a far larger extent than is reasonable, to the detriment of the owner; or, on the other hand, by a sharp rise in the market he may be reimbursed not at all, or driven to the verge of bankruptcy. For the purposes of the Government, therefore, a lump-sum contract was discarded both by the Construction Division and by the Emergency Construction Committee of the Council of National Defence.

The same objections are inherent to a variation of the lump-sum contract in general use, namely, the lump-sum contract to cover the cost of the main project, with a cost-plus provision for such changes and expansions as may be ordered.

Another form of contract, admirable under certain conditions, but not adapted to the use of the Government during the war, is the unit-price form of contract, whereby a fixed price is agreed upon for construction units, as for example, per thousand bricks in the wall, or per yard of concrete in place. Any estimate, unless it be speculative, must be based on an approximately accurate knowledge of the conditions under which the construction must proceed and the number of units to be completed. Obviously, the volume of the work will have much to do with the estimate. Many of the objections inherent to the lump-sum contract are attached also to this method.

The agency form of contract and its advantages and objections are well known. For undertakings of a peculiar character and of great magnitude wherein conditions of the utmost mutual trust and confidence can be imposed as between principal and agent, it may work admirably. Under ordinary conditions, it is hazardous and has never been a well-established practice in the contracting business.

The contract which finally was adopted for the building of the camps and cantonments is known as the emergency form of contract. In popular language, it is called a cost-plus contract, but strictly speaking it is not exactly that, but a modified form of the cost-plus idea. The natural advantages of this form of contract are well recognized, and this method of contract for the performance of construction work has been for a number of years steadily growing in favor. It is equally flexible for large and small projects, and adjusts itself automatically to variations in plan and to additions to or curtailments from the original estimates. It is equally valuable in stable or unstable market conditions. Under it work can be started as soon as the organization is on the ground, and the planning of the work can go hand in hand with the actual construction. The disadvantages are that it requires vigilance on the part of the owner, a painstaking check upon all construction costs, and that it encourages extravagance on the part of the contractor and offers temptations for increased cost, accompanied by increased compensation to him.

In the contract adopted, the cost-plus principle governed but there are a number of variations from the usual cost-plus contract. There may be cost plus a fixed percentage; cost plus a flat amount; cost plus a sliding scale of percentages, the percentage decreasing as the cost increases; or cost plus such a sliding scale with an upset price fixed, beyond which the contractor can receive no compensation, no matter what the cost of the job. The last named of these forms was the one adopted by the Construction Division with the advice of the Committee on Emergency Construction. In the original contract for the cantonments, if the cost of the work was under $100 000 the contractor's fee was 10 per cent.; if over $100 000 and under $125 000, 9 per cent.; if over $125 000 and under $250 000, 8 per cent.; if over $250 000 and under $266 66.67, $20 000; and so on down, until it was provided that if the cost of the work was over $3 500 000 the contractor should get a fee of 6 per cent. A special provision was inserted into the contract that the total fee to the contractor should, in no event, exceed the sum of $250 000. These figures were inserted, as I say, in the original contracts for the construction of the National Army cantonments where the cost was estimated to run about $6 000 000 each. Based upon such figures, the contractors' fees would have been about 4 per cent. of the total cost of each project. Actually, due to alterations, enlargements and changes in plans, the cost ran in every case considerably in excess of what had been anticipated. The $250 000 fee, however, remained. It will be observed that, based upon a foundation of percentages, the contractor passed, comparatively early in the building program, the point where all of his fee had accrued. In other words, after this point had been passed, his fee was not increased by a single penny. Consequently, it was to his advantage, both for his reputation and to cut down his own overhead, to finish up the job as speedily and economically as possible.

This principle has been followed with all the emergency construction work done by the Construction Division. The upset fee, of course, has varied in size as the jobs varied in size, but in all jobs of magnitude it has remained constant at $250 000, except in one instance where, by special arrangements, it was made larger on a job costing between twenty-five and thirty million dollars. If, on the other hand, it was anticipated that the project should not cost more than a million dollars, the fixed sum, which could in no case be exceeded, representing the maximum fee which the contractor could get, was made correspondingly smaller. The effort was constantly to check any possible tendency toward extravagance or prolonging the job, in order that the fee might be correspondingly enhanced. It is only fair to the contractors to state that this tendency, the possibility of which is very generally recognized and the existence of which was quite widely asserted by persons not familiar with the War Department construction, was never noticeable, and I believe it never was consciously a policy which any contractor on our jobs tried to follow. None the less, the insertion of the upset fee, judiciously calculated to correspond with the probable cost of the work, was a safeguard the moral effect of which it is hard to overestimate. If any such tendency had existed, it would have effectually operated to check it by rendering such a course of action quite as undesirable from the contractor's standpoint as from that of the Government. It was an answer to charges of ill-advised and gratuitous critics of War Department construction work to which they could never find a satisfactory rejoinder.

The percentages have been changed from time to time, in accordance with the lessons of experience, but the fundamental principle governing the form of contract has been retained all through the construction work for the army during the war. It has been proved to my satisfaction, and to the satisfaction of those who have followed the work, that this form of contract has worked as well, probably, as any scheme of human devising ever does. The tendency to unwarranted extravagance on the part of the contractor is effectually checked, if not prevented, and, coupled with a jealous and effective system of auditing' also provided for in the contract, the rights of both parties are amply protected.

Under this scheme, work on the camps and cantonments was begun between the 20th of June and the 6th of July. Materials were, for the most part, mobilized through the office of the Construction Division. Its representatives, commissioned officers with the title of constructing quartermasters, were on every job. Each constructing quartermaster had his office organization and his engineering assistants to help him in supervising and administering the work on the job. The Government force of auditors began its operations coincident with the starting of the work, and under almost impossible conditions the camps and cantonments were built, — and built on time, — providing for the accommodation of over a million men in a period of about three months. In view of the conditions under which much of this construction work had to be done, I think we are justly entitled to consider it a feat of unusual accomplishment. In the construction of each cantonment, thousands of carloads of freight had to be handled and millions of feet of lumber were nailed up. In many cases, extra railroad facilities were necessary for the handling of the materials, and, due to the location of the sites, it was necessary to import labor from a distance.

The work of the Construction Division itself was sufficiently great. It had on its own account to draw, coördinate and complete plans, twice changed, once on account of the changes of the tables of organization of the army, and once because of the requirements of the office of the Surgeon-General regarding the cubic air space necessary per man. It had to prepare contracts and attend to the selection of contractors, appoint constructing quartermasters, obtain supervising engineers, organize and put into the field auditing organizations. It had to scour the material markets of the country for all of the tremendous quantities of every kind of construction material necessary; engineering problems had to be foreseen; sanitation had to be scrupulously looked after, and sixteen cantonments at an estimated cost of $6 000 000 each and with an estimated capacity of forty thousand people each, and sixteen tent camps at about half the cost but with nearly equal capacity constructed. In the construction itself, the commercial organizations did the actual work and are entitled to the utmost credit. They did the job and did it well, but the planning, the coördinating and the administration were the problems of the Construction Division.

Without the form of contract which was adopted, it is a certainty that the camps and cantonments could not have been built. It worked so well in these projects that it has been in use, with non-essential modifications, ever since and in all kinds of construction work. It has given universal satisfaction to the division and to the contractors.

At the time of the signing of the armistice, there were four hundred and forty-one separate projects in the United States, completed, or under construction, by this division. It had built hospitals fully equipped with every appliance of modern science, with 121 000 beds; storehouses containing over 700 acres of floor space; 39 000 feet of docks, capable of handling 65 ships at one time; 1 080 miles of railroad tracks; 1 100 miles of highways; housing for 2 250 000 men; with incidental sewer systems, water supply systems, lighting and power plants.

During a period of sixteen months its disbursements were $50 000 000 per month, — more money than was disbursed in the building of the Panama Canal during any year of its construction. The total cost of that project was $375 000 000, covering a period of ten years, and the annual disbursements never extended over $49 000 000.

As the work increased and the program ahead became more diversified, the thought came into the minds of the officials of the Construction Division that some other form of contract might work better than the one adopted, or that some modifications might be advisable. Accordingly, the War Department appointed a committee consisting of engineers, architects, business men and contractors, to go into the subject and make recommendations. The committee was composed of Prof. A. N. Talbott, president American Society of Civil Engineers; John Lawrence Muran, president American Institute of Architects; John R. Alpine, representing the American Federation of Labor; Frederick L. Cranford, president General Contractors' Association of New York; Charles T. Main, president American

Society of Mechanical Engineers; Oscar A. Reum, representative of the president of the Building Construction Employers' Association of Chicago, Ill.; R. S. Rhett, president of the Chamber of Commerce of the United States; and E. W. Rice, president of the American Institute of Electrical Engineers.

A brief extract from the findings of this distinguished assemblage of experts might profitably be inserted here. After reviewing the form of contract under which the operations of the Construction Division were being carried on, the report says:

> " No reasonable objection can be pointed out by any one possessing a full understanding of its equitable operations and practice, and finally this scheme appeals to the committee as possessing one qualification which must commend it to all thinking men, — it permits starting actual work weeks, and even months, before the details are completely worked out and delineated, and permits the Government to push the job at any speed it may elect, changing at will its plan and scope, but paying only what the work actually costs, plus a fee which is so reasonable as to be above the reach of fair-minded criticism. The committee therefore advises for emergency construction work . . . the scheme of contract known as 'cost of the work, plus a sliding scale percentage with a maximum upset fee.' "

In all the vast program of building, both that of the simplest nature and that which presented the most difficult technical engineering problems, this form of contract has worked smoothly and well. Whether or not it can be employed to equal advantage during ordinary times and under normal conditions, may be open to question, but I can think of no valid reason why it should not be, given the safeguard of proper checking of costs on the part of the owner or his representative. It relieves the contractors of most of the hazards of that most perilous of undertakings, — figuring on a big job in times of unstable market conditions. It relieves the owner of the payment of an extra fee representing the amount which the contractor must add to his bid as a safeguard against a possible rise in the market. It is at least worthy of careful consideration, and is, no doubt, capable of further refinement and perfection.

Possibly this contract would not be the best for ordinary small building operations such as those conducted by individuals building their homes or small commercial buildings. It might be difficult for the owner to keep in action a system of auditing and checking which is essential to proper operation under this form of contract. I am far from desiring to create the impression that contractors are naturally dishonest and have to be watched. On the contrary, I am very strongly of the opinion that no body of men in the country are more jealous of their reputation or realize any more vividly the value of an established name for honesty and fair dealing, but when every expenditure made by a contractor is paid for by the owner and these expenditures themselves are made the basis of the contractor's remuneration, it is only just to him, as well as to the owner, to have a careful and accurate audit of all such expenditures. Such an audit is probably impracticable in small building operations.

In such operations, given market conditions of normal stability, the ordinary lump-sum contract should work well. Usually there is no difficulty in knowing just about what is desired, and as time is ordinarily not of the essence of the transaction, there can be close and careful estimates made and bids submitted which will be fair alike to both contracting parties.

It is not with this class of building operations that I and this audience are principally concerned. I have in my mind jobs which cost from half a million dollars upward. Here we are met with different circumstances, and these call for different methods of operation. I believe that it is in such a field that a contract approximating the one which the Construction Division has used during the war will have most value. It is in figuring contracts of this size that the element of chance enters most largely. Contracting on a large scale is a gamble. The contractor wants the job upon which he is figuring, and he desires to do it more cheaply than his competitor, but at the same time he is, if he desires to remain solvent, exceedingly careful not to be caught by changes in the market or by labor disturbances. Some margin of safety he must have, and for this margin of safety the owner pays. There is inevitably a sum larger or smaller as the case may be, but always, in big operations, very considerable, over and above the amount of profit with which the contractor would be satisfied, which the owner has to pay — that is, the margin of safety. When a contractor figures a lump-sum contract, he takes a chance. All he desires is a fair and just remuneration for his work, his experience and the use of his organization, over and above the expenses to which he is actually put, but he is taking chances not only on wind and weather and the ordinary hazards of building, but he is also gambling on the market, on its stability, and in order to play safe he has to put his figure higher than the sum which he would be willing to accept if he was assured of safety. Even then, sometimes he gets caught. Cast about in your minds and try to remember how many contracting firms have been forced to the wall or have been seriously crippled because of an unfortunate bid upon some large building project, apparently safe, perhaps, when it was made, but which resulted disastrously for the contractor. I contend that the lump-sum contract in large operations works a double hardship: on the owner, because he pays more than he should have to in order to insure a measurable degree of safety to the contractor; and a hardship to the contractor because in spite of sound business judgment, good estimating and a knowledge of conditions, he sometimes inevitably is financially embarrassed or rendered totally insolvent through changes in the market or fortuitous circumstances which he could not foresee.

I believe that the cost-plus contract, with a definite fixed sum, and with suitable auditing and checking, is the way out for both parties, and I commend it to the great organizations of this country concerned in the building of its gigantic construction operations for consideration.

Before I close, I wish to allude to the advantages which always come from the consolidation of construction work of great size under one central authority, composed of an organization of experts in that particular line. The Construction Division was exclusively composed of men drawn from civilian life eminent in their professions, — architects, engineers and builders. It was charged with construction work and construction work alone. It was not burdened with side issues; it had nothing to do with anything but providing the necessary building for the War Department. Soon after it had demonstrated its efficiency, in October, 1917, the Secretary of War placed all of the War Department construction work under its jurisdiction. Formerly the various bureaus, — the Signal Corps, the Ordnance, and other divisions of the War Department, — each, in addition to its other specialized duties, had been undertaking to do the building necessary for the accomplishment of its particular task. It is no reflection upon these bureaus to say that the results were not all that they might have been. Building was not their job; it was a side issue. When building was all consolidated where it should be, under a department devoted exclusively to that task, an improvement in results was almost immediately noticeable.

The same principle might, it seems to me, be applied to our Government on an even vaster scale. At present the Government construction work is being carried on by the various executive departments, which each handles independently of the building incident to its particular functions. The Treasury Department, the Navy Department, the War Department, the Department of Agriculture, the Department of Labor, the Department of the Interior and the United States Shipping Board, are each charged with the construction work of its own governmental functions. In other words, these departments are all, to a certain extent, bidding against each other; each is undertaking, as a sort of side issue as it were, a task which is not directly connected with its ultimate object or purpose. It would be well, in my opinion, to consider very seriously the formation of a Department of Public Works under which would be consolidated all of the building for the Government. A moment's reflection will convince any one of what a tremendous executive branch this would constitute — a branch expending probably twenty per cent. of the annual appropriations made by Congress. That such a branch, properly constituted and combining in itself the best talent of the various engineering bureaus and architects from civil life, which have been brought in to assist in the emergency, could effectuate tremendous savings and could accomplish the Government building to far greater advantage than it is at present being conducted, is indisputable.

A closer *rapport* between the Government and the great contracting organizations would be possible; and also — a thing of tremendous importance — closer and more intimate relationship between the Government and the great engineering societies of the country would result. These organizations and associates are indispensable, of course, in time of peace as well as in time of war; but when a national crisis is at hand their aid must be enlisted at once, and in times of crisis, speed is the essence of accomplishment. During the past few months, so filled with events, the response of these organizations and societies has been so generous as to be inspiring, but from the constitution of the governmental agencies with which they had to deal, the greatest measure of good has not always been possible. With the establishment of such a Department of Public Works, it would be the one agency with which they would all be in more or less constant touch and by which they could be recruited at any time of need. My own idea is that such a department should be under a Cabinet officer, and that, properly administered, it would be second in importance to scarcely any of the executive branches of the Government.

I realize that this has been a rather rambling, possibly rather a disjointed talk. I realize, as I said in the beginning, that the subject is too big to treat except along the very broadest lines. If I have succeeded in opening up for your consideration any lines of thought to be pursued by you to the betterment of the economic conditions of this country, I shall feel more than repaid for having inflicted it upon you. It is inevitable that I should have certain more or less firmly fixed ideas as the result of my intimate association for nearly two years with the biggest building program that the world has ever seen, but that these ideas are necessarily, or even probably, perfected or worked out in anything like finished shape, I am too modest to believe. The next few years will offer wonderful opportunities to the engineering brains of America, and the lessons of the construction work undertaken during the war should be a storehouse of inestimable value. I hope it is not necessary for me to assure any society of engineers that the War Department will always be ready to reciprocate the generous help which the engineers of the country gave to it, and to put at their disposal its counsel and its experience.

DISCUSSION.

FRANK M. GUNBY.* — I thought I would show you pictures of some of the work that we have done. These pictures are not going to be an attempt to show in detail any of the work, but more to give an idea of the diversified character of the problems or branches of work to be met.

I will not go into detail even on those particular projects. Each one of them simply represents one of a type of anywhere from one to fifty different installations, of just enough different character to keep you interested.

In connection with the emergency construction contract, I want to say that I think a tribute is due to the farsightedness of the men who evolved or put together that contract. I say "put together" advisedly, because it is a combination of forms of contracts used by engineers and contractors all over the country, with just enough modifications of the good points selected from various contracts to fit it into governmental procedure.

As we were spending Government money, we had to spend it the Government's way. Sometimes that slowed up the game, as compared to what could be done without such requirements, but I think it is a further tribute to the judgment of those men to say that, due to the business scheme that they laid down and the type of contract they worked out, supplemented by the administration of that contract by the Construction Division, the Construction Division was utterly uninterested as to whether Congress passed that validation act or not. There wasn't a single informal or illegal contract in the whole war construction program as administered by the Construction Division.

Some of us in our previous experience have viewed with tolerance or kindliness, and even with enthusiasm, the use of the lump-sum contract for construction work. I was in that category and always had the feeling that where that form of contract fitted, it was probably the best to use. The experiences of this war have led me to believe that there are certain limitations that we should understand in applying that contract, and I will give you what my opinion of them is.

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* Colonel, Quartermaster Corps, U. S. A., in charge of engineering, Construction Division, U. S. A., Washington, D. C.

I say this from the standpoint of having helped administer about 550 of the other kind (cost plus a limited fee), so I feel a little bit qualified to say something about both.

I would be a bit inclined to establish as proper conditions for a lump-sum contract, three things :

First, an ability to clearly define what you are contracting for. Meaning by that, definite plans and specifications, both as to the limits of what you are contracting for and the type of what you are contracting for.

Second, that you be able to limit the bidders to men of such reputation that you do not care which one of them gets the job.

Third, that the job shall not be so large as to extend over a period of time too long to assume that a contractor can, with a fair degree of definiteness, predict both his labor and material conditions. My own idea is that the upper limit of the lump-sum contract according to that definition would be somewhere between a quarter and a half million dollars. For all work falling outside of these limits I would advocate a contract similar in principle to the emergency construction contract.

Fig. 1 is a picture of Camp Lewis, at Tacoma, Wash., and is typical of most of the first cantonments. We started in with 16 cantonments and 16 camps. I think there are something over 40 now, — that is, 40 fairly large ones.

This shows the original type of barracks building, which was a large two-story building, housing one company of men, a company at that time being 150 men. One of the little jokers they rung in on us afterwards was in making a company 250 men, — which pretty nearly doubled the floor space required. Roughly speaking, three of these buildings now house two companies. That camp site is really one of the best suited for camp purposes of any we have, because it has a nearly ideal combination of climate, soil, railroad facilities, water, and pretty nearly every other thing that is needed.

The general scheme of handling storage was one of the most difficult to settle at the beginning of the war. As worked out,

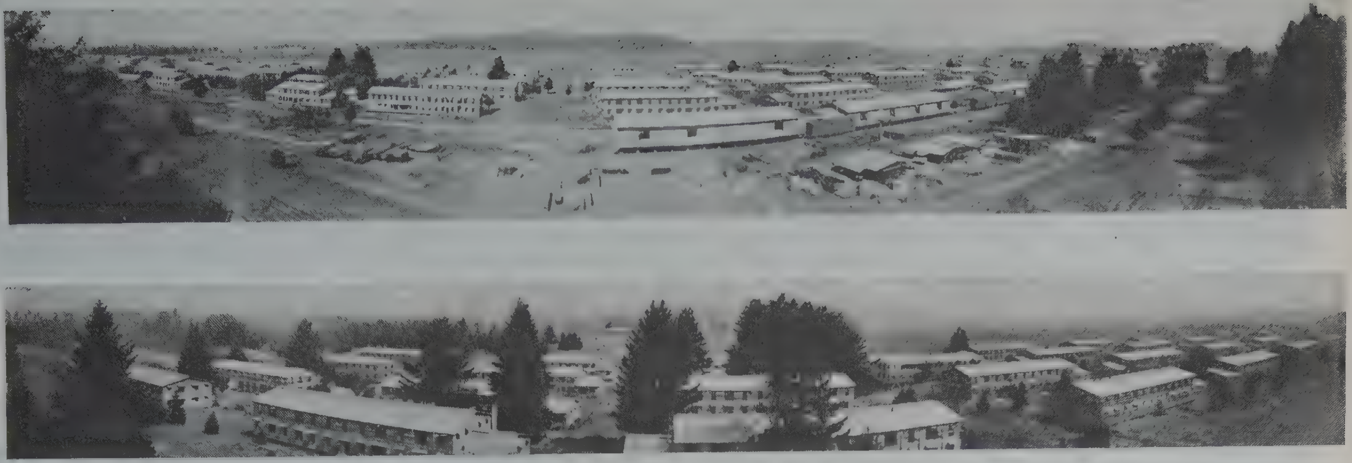


Fig. 1. Camp Lewis, Tacoma, Wash.

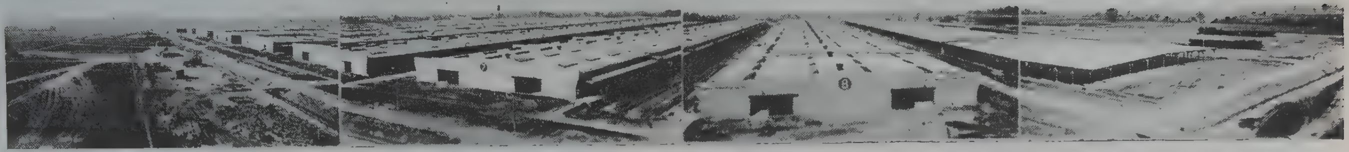
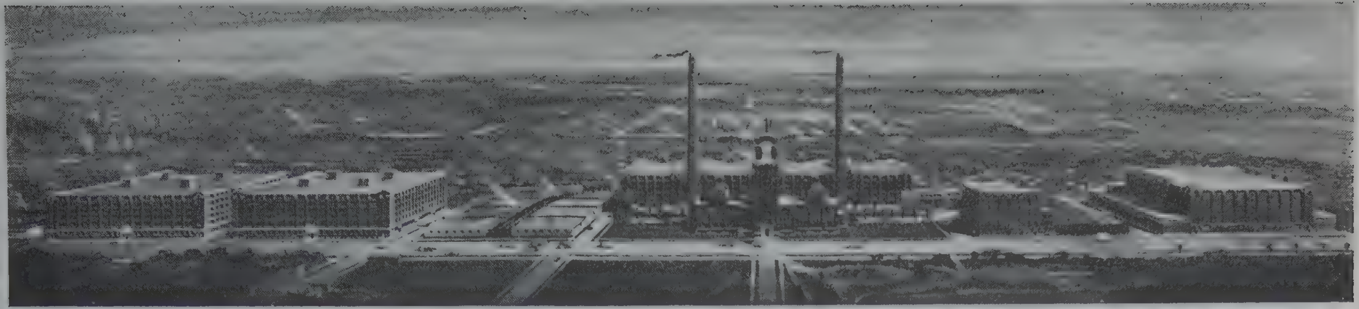


Fig. 2. Storage Plant at Columbus, Ohio.

however, the plan of development called for the building of interior storage depots conveniently located as to railway and manufacturing facilities and for the use of these as storage reservoirs for the terminals at the seacoast, like Brooklyn and Boston. I might say, had this storage as it was later visualized, and now constructed, been ready in the summer of 1917, the scandalous railroad conditions that occurred in the middle of that winter would probably have been eliminated to a very large extent. At that time, however, every bit of storage space in the country was filled. There was also no way of unloading the railroad cars when they arrived on the Atlantic seaboard. On account of this, freight shipments practically had to cease until the next spring, when we could begin to handle them again.

One of these interior storage depots, that of Columbus, Ohio, is shown in Fig. 2. The picture gives a good idea, though somewhat distorted, of the group of eight large warehouses and one covered shed built at that point. Each one of these warehouses is a fireproof building, 160 ft. wide and 1 540 ft. long, and one story high with the exception of one, which provides office space on the second floor. Speaking of these warehouses as typical of the interior depots and similar storage projects, the walls are usually of tile with either wood or concrete floors, depending on the location; generally concrete, however, if we could get it down on the earth. The one open storage building, shown at the extreme right, is principally mill construction. Each building gives about 22 000 sq. ft. of floor space per storage compartment. In general, there are no openings through the fire walls between these compartments, and these walls, extending to the ground, make each compartment an entirely separate fire risk. The question of fire risks in these various storage depots is one that has been made absolutely standard practice, and every project is not only so designed that should a fire occur in one compartment it will not get over into the next one but in addition they are provided with sprinkler systems, a yard pipe and hose system and a complete fire department. From the fire standpoint this practice has proven good, and the reputation made has been even better. The illustration also gives some idea of the length



Permanent Chicago Depot Warehouses. Temporary Warehouses. Central Mfg. Dist. Power Plant, Montgomery-Ward buildings in background. White City Cold Storage Plant. U. S. Government Cold Storage Warehouse.

FIG. 3. PERMANENT QUARTERMASTER DEPOT AT CHICAGO.

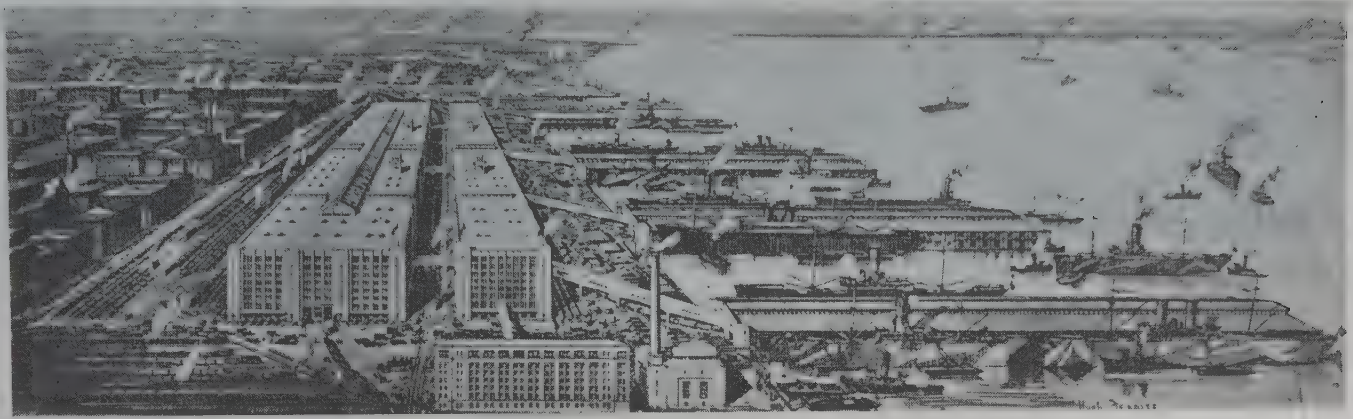


FIG. 4. COMBINED STORAGE AND PORT TERMINAL AT BROOKLYN, N. Y.

of the buildings and the wide platforms extending down each side. I was at Charleston a little while ago, inspecting the Charleston Terminal, which is similar in character to the one at Columbus, and suddenly discovered I was dodging some Ford cars that were running on these platforms, using them for a roadway.

Each storage development had to be located outside of the city, both on account of the space occupied and the necessity for good railroad facilities. In every instance, it was necessary to build barracks to house the troops operating these jobs. The barracks at Columbus are to the right of the picture and do not show in this case, but they are typical cantonment buildings, and some idea of them is given in the illustration of Camp Lewis, Fig. 1. The number of troops to be accommodated was usually from three to five thousand at each depot.

There are two things about cantonments I should like to mention here. The first is that we have yet to have our first case of water-borne disease in any cantonment in America or in any camp; and second, that the fire-prevention people, when they got through grouping the buildings, told us that we would never lose more than one building at a time by fire; and we never have. We have lost a good many buildings, but never more than one at a time, so that the conflagration risk is a thing of the past. As far as I know, that is a record about six times as good as you get in an ordinary city. It is further substantiated by the fact that the losses per capita in the cantonments have been just about one sixth of what they averaged in forty different cities taken at random during the same period, and the fire record established at these interior storage points has been equally good.

Another type of interior storage depot built by the Construction Division is the permanent quartermaster depot at Chicago. (Fig. 3.) This, and the sharp freezer plant nearby, also built by the Construction Division, are on the land of the Central Manufacturing District of Chicago, a realty company using the same railroad facilities as the stockyards. The first of this group was the permanent depot warehouse, a six-story building of reinforced concrete in two units, and similar in construction to the per-

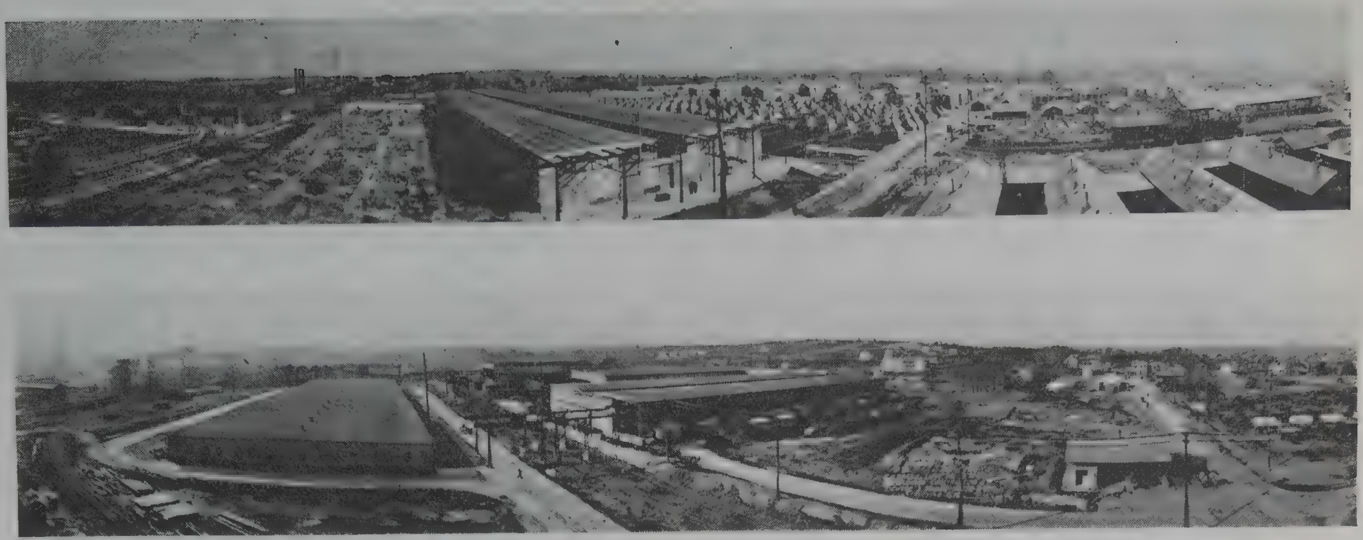


Fig. 5. Mechanical Repair Shop at Camp Holabird, Baltimore, Md.

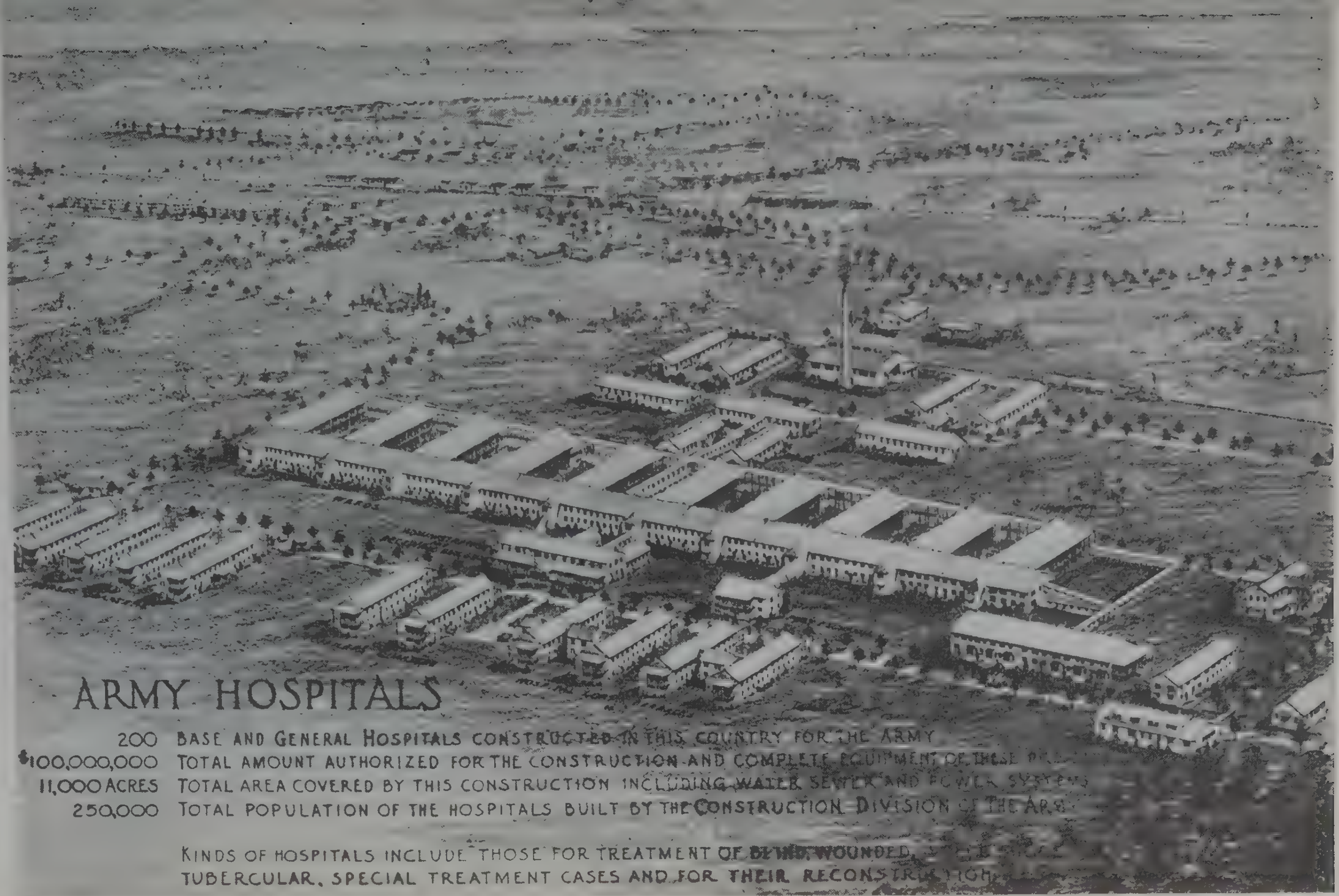
manent development here in Boston. This building shown at the left of Fig. 3 was completed in July, 1918. The two equal wings of the building are connected by a bridge. There are railroad tracks behind the building and entering the basement, so that all material may be handled from the first story by elevators and ramps. In the center of the picture is the power plant belonging to the Central Manufacturing District with its two stacks. At the extreme right is shown the cold-storage building erected for handling beef in trainload shipments to the seacoast, and thence to France. This is the largest sharp-freezer plant in the world and has a sharp-freezer capacity of over 20 000 quarters of beef and a cold-storage capacity of over 200 000 quarters. Besides this, about 150 tons of ice per day are made. The freezer plant also has direct accommodation for loading and unloading 50 cars of beef at one time. The building has just been finished and will probably be traded back to the stockyard people, or perhaps for some other storage building, though all of these buildings, however, were erected under a contract with the Central Manufacturing District, that they would buy them back at an appraised valuation in case the Government wished to sell them.

Another type of storage project which is more or less familiar to Bostonians is the combined storage and port terminal, seven of which have been built along the Atlantic coast during the past year. The terminal at Brooklyn is the nearest competitor to Boston and started about the same time. A perspective drawing of it is shown in Fig. 4, and those of you who are familiar with the Boston terminal will see that it is somewhat different in plan. It will cost a little more money, probably over thirty million dollars, and is likely to be one of the things you will find standing in the road sometime when you want to get more business for the terminal here. The two storage buildings seen in the left center of the picture are eight stories high, with basements. Railroad tracks come in between as well as along the two outer sides. The two buildings are connected with each other by bridges and there are also similar connections to the three piers and to the administration building and power house in the foreground. The railroad yards, at the left of the two large storage buildings, connect with the Long Island Railroad. On account of its location a large amount of car storage is necessary and the storage and classification yards can be seen in the illustration. There are sixteen miles of track with a capacity of about 1 200 cars, and the development as a whole was designed for handling at least 10 000 tons of material a day. Four piers, shown in the illustration, are each 150 ft. in width and 1 270 ft. long, giving a total capacity for loading and unloading 16 ships at a time. The general scheme is somewhat different from the Boston development, where the bulkhead type is used. Each pier at Brooklyn has a two-story shed, giving 375 000 sq. ft. of floor area each They propose to run cars along the sides of these buildings as well as in the case of the eight-story buildings, and then, with a crane on top of the warehouse and little loading balconies, it is possible to handle freight direct from the cars to the various floors without going on the elevators. The buildings are all laid out so that they can be used in the future for manufacturing purposes if necessary.

Another type of work is the mechanical repair-shop unit. Three of these have been built to date, — one at Baltimore, another at Atlanta and the third at San Antonio. The necessity for these is due to the fact that there are something like 35 000 motor cars in this country, of one type or another, belonging to the army. These all have to be cared for, and the three motor repair-shop units are supposed to do this, the idea being to standardize all heavy repair work wherever possible. For instance, if an engine is to be repaired, it has been found much better not to repair the individual engine but if the cylinders have to be re-bored, to re-bore them to the next size and put in a new set of piston rings. In this way the engine is kept standardized, and the records will show at any time just what the status of all the machines is. This standardization of equipment has solved a great many of the army problems. The plant at Baltimore has been added to recently in order to provide facilities for crating trucks for overseas shipment, the general scheme being that trucks go down to the seacoast with their own power, are dissembled and packed at this repair shop and then shipped abroad in the least possible cargo space. The motor truck ready for shipment consists of two packages, one about 40 in. square and 20 ft. long and the other measuring only 1 by 6 by 12 ft. Like the storage depots, these projects also require a considerable force of men to operate them. Camp Holabird, at Baltimore, for example (Fig. 5), has buildings to accommodate 7 500 men and officers, of whom 3 000 operate the shops while the others are in training for similar work overseas.

The hospital units built by the Construction Division have played an important part, and will probably continue to do so for some time to come. However, as we now have hospital accommodation for about 120 000 beds in this country and have only about half that number of patients, I think we need not get very much excited about the general situation at the present time. This excess of accommodations is due to the fact that we were just getting under way on the general program of having hospitals in various districts in the country when the war stopped. Under this program the patients would be interned somewhere near their homes, so that their relatives and friends could see them without an unnecessary amount of travel. In addition to providing space for the wounded and disabled, we had also to provide for the personnel operating the hospitals, such as doctors, nurses, orderlies, guards and so on.

A typical base hospital is shown in Fig. 6, and is made up of the following units. The ten wards for the patients are the wings extending back from the long building, the head house in the center. Each ward is of two stories, with outside porches and connecting corridors to the other units. This group, like all the hospitals, is built up of the requisite number of wards desired for the total capacity of the plant. If, for example, a hospital for 1 500 patients is to be built, 15 of these wards must be provided for. Beside these, there is the administration and receiving building, just in front of the head house, then across the street from that the quarters for the nurses, officers and the hospital corps barracks with the operating building, Y. M. C. A., laboratory and Red Cross buildings in the right foreground or at one end of the plant. Behind the wards or to the north are the mess, kitchen, shop, storehouses and power house, with the garage and guardhouse at the extreme limit of the project. The head house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TUBERCULAR, SPECIAL TREATMENT CASES AND FOR THEIR RECONSTRUCTION

Fig. 6. Typical Base Hospital.

connecting the wards is composed of various rest rooms, diet kitchens, surgeon's office and other offices and special rooms which go to make up a typical up-to-date hospital. The one shown in the illustration is designed to accommodate a thousand patients and it will be noticed that there are ten ward pavilions. The exits from the wards are at other end and all of the units entering into the operation of the hospital, such as the receiving building, post exchange, operating pavilion and the wards themselves, are connected by covered corridors, so that a stretcher may be carried under cover from any one portion of the hospital to another. The buildings are protected by fire walls, and the later hospitals are built of tile and stucco. All of them have wood interiors because we did not have time for anything else. The space between the wings is 60 ft., and ample precautions have been taken in all cases for proper fire protection. I might say that we also have had no fire difficulties at any of the hospitals.

We were criticized at one time because our hospitals were costing about thirteen hundred dollars a bed, where they told us they were building civilian hospitals for eight or nine hundred per bed. We analyzed it and found out that about five hundred dollars out of our thirteen hundred dollars was for facilities which would be furnished from the existing conditions in old cities. That is, in the form of water, sewer, electric light and housing of the doctors and nurses, and that sort of thing.

Then we found the other fellow had made a mistake in his figures. Instead of building at eight hundred, it was fifteen hundred dollars per bed, so the net result on the same basis of comparison was that we were building at eight hundred for temporary construction, while the permanent construction in civilian hospitals cost about fifteen hundred.

I am not going to attempt to explain the Boston terminal to you, gentlemen, because Mr. Fay, Major Gow and Mr. Kearns have explained it to you.

Concerning the developments at Boston, New York, Philadelphia, Norfolk, Charleston and New Orleans, the next problem is what are we going to do with them?

They were built by the War Department from funds appropriated for use during the war, and they have a good reason for having been constructed. It seems to me that in considering any use that we might have for those buildings our first consideration ought to be that they were built for war purposes and ought to be kept for such. I do not mean by that kept empty, but kept so that the War Department in case of any future need has them.

Accepting that principle, you almost automatically knock out the idea of manufacturing in them, because if you do, the first thing that happens if the War Department has to take them back is, you would wreck those manufacturing establishments and you would by that process lose one large source of taxes for the Government and lose manufacturing capacity at a critical time also.

It seems to me those terminals must be used as terminals. That is what they were designed for. That is what they will find maximum use for, and as we are now getting some ships on the sea, it seems to me it is necessary we have a place to land them, and these terminals are, I believe, very nearly the only ones in America that have well-balanced storage behind them to take up the slack between railroad transportation and shipping transportation, so we ought to make use of them.

If that is the case, it seems to me these things ought to be operated by the communities themselves. That is, not by the whole Government perhaps, or not by any syndicate representing all the terminals but by a syndicate controlled by each community in which one of these plants is located.

That syndicate would naturally have the viewpoint of wanting to get the most business into its community. If one syndicate operated them all, you would have a tendency to have some port perhaps favored at the expense of others. Certainly if they are operated by a syndicate of your own people, you can only blame yourselves if the other fellow gets more business than you do.

I believe one of the principles of any syndicate like that should be that the standard of success is not how much money the syndicate is making, but how much business it is getting into the community. By the community, I mean the whole section of territory that will be served by these terminals.

I just want to leave these thoughts with you to see if they bear any fruit. I thank you, very much, gentlemen.

H. R. STANFORD.* — The Secretary of the Navy has requested that officers refrain from taking part in public discussions. I will interpret that request as meaning the expression of opinion or views or taking issue with statements or giving personal opinion regarding debatable questions.

I think it proper, however, to give a brief statement of the work that has recently been done by the Navy in this district, in the nature of public works improvements.

There has been one principal operation, — that at Squantum. It involved an expenditure of approximately thirteen and one-half million dollars, and is an improvement designed and created for the assembling of a number of torpedo boat destroyers, the work to be performed by the Bethlehem Shipbuilding Corporation. That construction was performed under a cost-plus percentage basis, the same as the Boston Army Supply Base terminal.

In connection with the Squantum plant there was a shop built at Providence at a cost of about one million dollars, for the building of the boilers; a shop at Buffalo, costing about three million dollars, for the building of turbine engines; approximately two and three-quarter millions of dollars were expended at the Blake & Knowles plant of the Worthington Company at East Cambridge, for power plant, buildings, tools, etc., for the building of pumps, and assistance was rendered in improving the plant of the Sturtevant Company at Hyde Park for building blowers. There were also certain improvements made by the Navy Department at the plant of the Fore River Shipbuilding Corporation and the Bath Iron Works, to facilitate work of shipbuilding at those places. Those operations are all more or less related and were all performed on a cost-plus percentage basis.

There were, beside those operations, various extensive improvements at other places, including additional buildings at Chelsea which provide approximately a thousand additional beds at a cost of about a million dollars; an air station at Chatham, involving an expenditure of one million two hundred thousand dollars; new storehouses, magazines and railroad work extensions at the Ammunition Depot, Hingham, at a cost of about one million eight hundred thousand dollars; camps at Bumkin Island and at Hingham, providing housing for about twenty-two hundred men at each place, with combined expenditure of about one million dollars; and barracks buildings, drill hall and school buildings for the Radio School at Cambridge at a cost of about four hundred seventy thousand dollars. A large reinforced-concrete storehouse, marine ways, machine shop, power-plant equipment and various other improvements have been made at the Boston Navy Yard, involving an expenditure of about two million three hundred thousand dollars. All of the above work has been done on a definite price contract basis except the original contract at Chatham, which was on a cost-plus percentage basis and involved an expenditure of about five hundred forty-seven thousand dollars.

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* Admiral, Civil Engineer Corps, U. S. Navy, Navy Yard, Boston, Mass.

Charles R. Gow.* — The war emergency contract is theoretically ideal for all classes of work requiring the services of a contractor. I say "theoretically ideal" only, because it is perfectly obvious that there are many difficulties of a practical nature which must be overcome before it can ever have universal application.

It is safe to assert, however, that under any other form of contract yet devised, the war construction program could not have been as successfully accomplished as was the case. The army had a vast amount of construction work to do which, to meet requirements, necessitated completion within a period of unprecedented briefness. By means of this form of contract it was possible to select the contractor and get him on to the site even before the general plans were completely outlined. The Government retained, throughout the progress of the work, entire control of operations, directing the contractor's methods and procedures whenever necessity required, changing plans, adding or omitting work, suspending operations in whole or in part, dictating labor or other policies and exercising, at its option, any function ordinarily delegated to the contractor, whenever changing conditions or events rendered such action desirable.

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* Lieutenant-Colonel, Quartermaster Corps, U. S. A., Constructing Quartermaster, Boston Army Supply Base, Boston, Mass.

The Government received in return the expert services, ability, experience and special qualifications of the contractor; the use of a trained organization skilled in the particular line of work contemplated and possessing a thorough knowledge of procedure, which resulted in the adoption of the most direct methods for prompt and economical completion. For this special character of service which the contractor brought to the Government's aid, a fee was paid, differing slightly, if at all, in its value from that paid to the engineer or architect for his particular expert service in the conception and design of the project.

In other words, the contractor was employed upon a professional rather than a commercial basis and his relationship was one of adviser and assistant to the owner, rather than an agent to carry out a specific detailed and inflexible agreement.

Under this form of contract the contractor is relieved from practically all financial risks and is reimbursed for the actual cost of operations as the work proceeds. While the maximum fee of $250 000, allowed under the war emergency contract, appears generous in amount, it is so only because of the magnitude of the work involved. In the case of the Boston Army Supply Base which has come under my immediate supervision, the estimated cost was $28 000 000. Upon the expenditure of the first $10 000 000 the contractor had earned the maximum allowable fee of $250 000, and was required to complete the remaining $18 000 000 of work without further profit. It is now known that the final cost will not reach the expected total, but assuming that it did, this fee would be equivalent to less than one per cent. on the cost of the work. As no reimbursement is made for cost of financing certain overhead and legal expenses, this percentage will be further reduced and, after allowing for the Government excess profits tax, the net return to the contractor will be less than one half of one per cent., certainly a very low rate for the valuable services rendered.

It will undoubtedly be argued by many that the average contractor cannot be trusted to give economical and honest services to the owner, unless held to some strict financial accountability. The reason for this suspicion is largely an outgrowth of experience with the lump-sum type of contract, wherein the owner and contractor gamble on the probable cost of the work. I realize that the owner, at least, will not exactly relish the appellation of gambler, but it cannot be successfully denied that the ordinary lump-sum contract contains several elements of chance, both for the owner and the contractor. The owner usually hopes to escape the burdens of many of the uncertain features in his work, and to this end insists that the contractor shall assume them. He invites competition in the hope that he may thereby receive a low figure for the work, knowing full well that the low bidder is accepting the chances of financial failure which the hidden uncertainties may bring. This is fair enough, in a way, since the contractor accepts the conditions as outlined for him by the owner, but to this extent the cards are stacked against him and he realizes it. He must, therefore, possess the gambling instinct and be convinced that he is a better player at the game of chance than is the owner, otherwise he must lose. He attempts to match his cleverness, in devising methods for overcoming the handicap laid against him, in opposition to the shrewdness of the owner who has drawn an intended iron-clad contract aimed to prevent advantage being taken of any possible loophole.

The two parties are thus put in antagonistic positions toward one another from the first, each seeking to prevent the other from gaining at his expense. Under such circumstances there can be no mutual regard for the interests of the two parties. If the owner has inadvertently omitted to cover a contingency which unexpectedly arises, the contractor cannot be blamed if he demands a strict financial adjustment of the consequent expense because he realizes that had the particular contingency fallen under some blanket provision of the contract, he would have to accept the resultant loss, with only the owner's sympathy to comfort him.

In the last analysis, neither owner nor contractor gains materially from this form of relationship. If an occasional owner succeeds in having his work done at less than actual cost or at a very low margin of profit to the contractor, there are many more instances in which, if the contractor does not realize an excessive profit, the owner still loses by reason of inferior workmanship, delays in completion or expensive lawsuits. On the other hand, while a contractor frequently obtains an exorbitant rate of profit for his work, his average earnings over a series of years are apt, generally speaking, to be disappointingly small. A brief review of the list of contractors whom any one of us have known will soon demonstrate the fact that very few have retired from their business wealthy.

I realize that many of you engineers, and probably an equal number of my contractor friends, will disagree with my analysis, and defend the lump-sum form of contract as offering superior advantages according to your viewpoints, but you cannot successfully deny that this type of contract has produced about as much, if not more dissension, than any other existing business relationship. Because of the gambling nature of the transaction, there is a mutual feeling of distrust between the contracting parties. Each party generally watches the other closely because he realizes that a premium has been placed upon dishonesty. Only in exceptional cases does the contractor concern himself with the owner's welfare, and then usually for shrewd business reasons. Occasionally, also, an owner may be found who is desirous that the contractor shall not suffer financial loss on account of his contract, but such owners are now generally committed to some form of the fee type of contract.

Before the fee type of contract can become universal, it will be necessary for both parties to alter materially their conception of responsibility. On the one hand, the owner must be brought to understand that the work is being done primarily for his benefit and that therefore he has no moral right to evade full payment for every feature of the undertaking, both known and unknown. It is his object to accomplish something which he is unable to do himself, because it demands training and skill which only an experienced and competent contractor can supply. There can be no valid objections, therefore, to the employment of a carefully selected contractor in whom the owner has confidence and who has demonstrated, in previous cases, his ability to satisfy his clients.

On the other hand, the contractor must come to appreciate the fact that only by establishing a reputation for honest, conscientious effort to promote the interests of his employer, can he expect to succeed in business. With a positive profit assured him in advance, he will be justified in accepting a much lower rate of return than is now required, to offset his frequent losses. He must be educated to the fact that his continued employment in his chosen line depends upon the economic and workmanlike results which he produces and that his interests and those of the owner are identical, so far as these features are concerned.

Whether this result can ever be obtained with the class of contractors produced by the lump-sum method of contracting, may be subject to some question, but, undoubtedly, an evolution is already taking place and there is a gradual growth in tendency, in most large communities in this country, toward a recognition of these principles on the part of certain contractors and owners.

It seems to me altogether probable that a further extension of effort in this direction will result in an approach toward perfection of detail and that the time may yet arrive when the contractors will generally be employed only because of their recognized fitness for the work to be done and for their reputation for honesty, economy and dependability in a business way, rather than because they are willing to take a gambler's chance of winning or losing on the basis of a lump-sum bid with the cards stacked against them.

William F. Kearns.* — I had not anticipated that I would be called upon to speak, but I am glad of the opportunity which is now afforded me to endorse all that Major Gow has said regarding the cost-plus contract. In the past I have been an ardent advocate of the lump-sum form of contract, but I have been converted during the last few years and I am now thoroughly convinced that the cost-plus is really the better proposition. It is certainly the more honest form, eliminating as it does that element of chance which is always present in the lump-sum contract. I do not think a more equitable form of contract ever has been devised. I hope it will soon be adopted generally, and it is going to be my aim to see that it is put into use wherever possible, both in private and public work.

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* Of W. F. Kearns Co., General Contractors for Boston Army Supply Base, Boston, Mass.

Charles T. Main.* — I can add very little to what General Marshall has said in connection with the cost-plus contract. When the form of contract was criticized by some Congressmen, I had the honor to be appointed on the commission to look into the form of contract and to report as to its advisability.

We sat for three days, and very carefully discussed every phase, every feature of all forms of contracts, and of any other method of conducting work of this sort, and the conclusions which the commission reached have been given to you by General Marshall. We were unanimous in the opinion that under the circumstances existing no other form of contract could be used.

I have been surprised and shocked at the remarks of my friend here, Major Gow, to find that during the most of my years of experience in engineering business I have been living such a checkered life. Up to within ten or fifteen years, I with all other engineers used the lump form of contract, and we thought we used it with very good success.

In those days the prices of materials and labor were not so unstabilized as they are at present, and wherever the conditions were definitely defined and we could make definite plans and write definite specifications, we thought, and I think contractors thought, that everybody was getting a square deal.

I know that one contractor thought that he was not a gambler when he was bidding on our plans, because he told me there was no fun in bidding on them as there was no guessing to be done, they were so definite; and many of my clients up to this day are very much opposed to any other form of contract and are willing to expend sometimes several thousand dollars more than they might otherwise on another form of contract for the purpose of getting rid of the complicated accounting system which looks like a bugbear to them, and they are willing to pay a contractor perhaps $10 000 more on the lump sum to do a job and have it done in a clean-cut way and have nothing to bother about in the accounting.

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* Consulting Engineer, 201 Devonshire Street, Boston, Mass.

I doubt perhaps if we ever, those of us who are the older members of the Society, will see the conditions so stabilized that we will be able to get lump-sum contracts on very much of our work, and I believe myself that the best way, the fairest way, to conduct the work is to do it on a cost-plus basis, but I have got to educate some of my clients to make them see that. If conditions ever get stabilized again, I am sure we are going back in some of our work to lump-sum contracts.

I think also that perhaps if we get the right contractor, and there are a lot of them, and I hold them in the very highest respect, that it is better for the engineer to have that form of contract. It seems to me to make less trouble in many ways. There are some disadvantages to the other form.

I think that the workmen on the job soon know that the contract is not for a lump sum, that it is on a cost-plus or cost-percentage basis, and they begin to slacken up in their efforts, and there are other reasons why work does not proceed as economically as it would under the lump-sum form.

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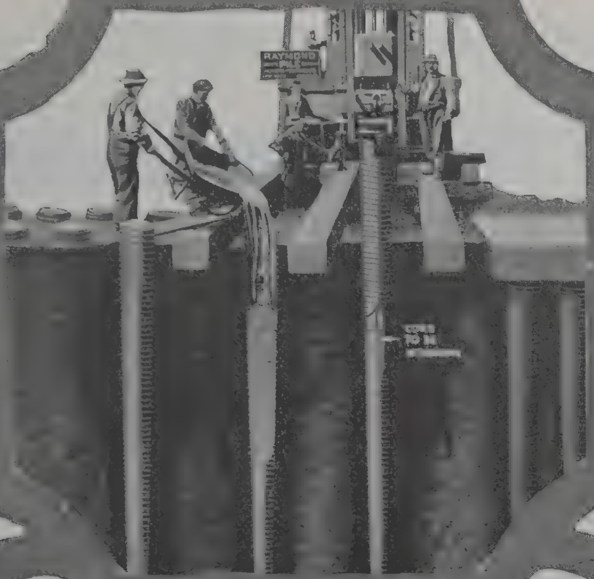

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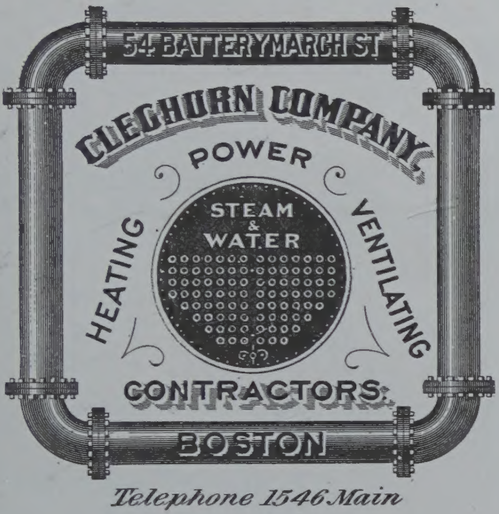

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